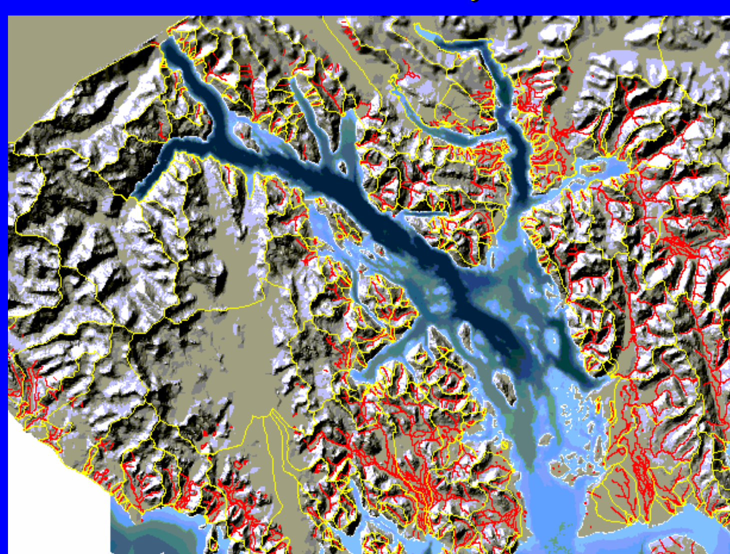
??? Monitoring Questions ???

- *Why*
- *What*
- *How*
- *How much*
- *Where*
- *How often*

The Importance of Design

- Goal: Develop a probability-based monitoring design
- Why?
  - Inference: probability-based design allows inference to the universe of the targeted strata/habitats
  - Scale: address Resource Managers' needs to understand dynamics of populations and communities at the broad physical scales found in many Alaskan parks

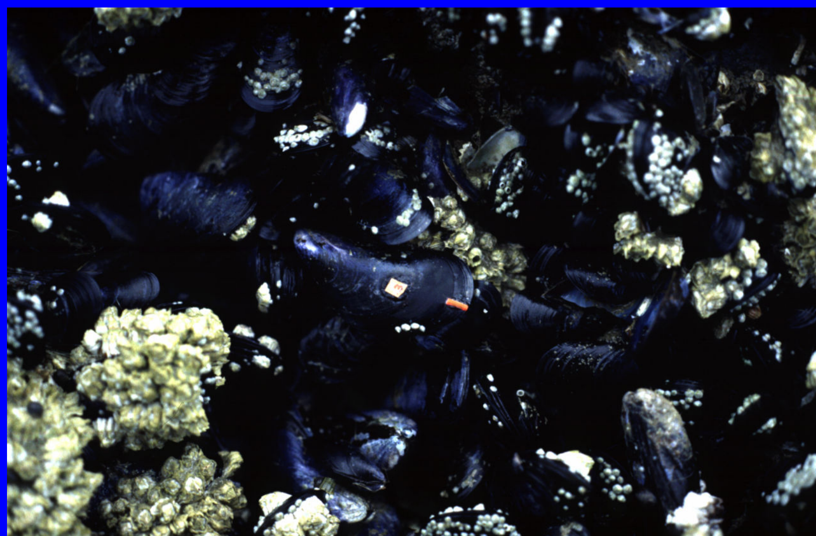
Glacier Bay



Approach

- Segmentation of coast (Glacier Bay proper= 1,109 km; GLBA total=1,720 km) into 200m-segments. For GLBA proper this yielded 5,545 segments
- Estimated could aerially survey 250 segments in a low tide cycle; therefore picked a random segment then identified systematic set of segments to be surveyed (every 23rd segment)
- Surveyed 241 segments for: categorical abundance of substrate type, predominant slope, categorical abudance of major intertidal species

Cobble/boulder- Bedrock Habitat



Approach – continued

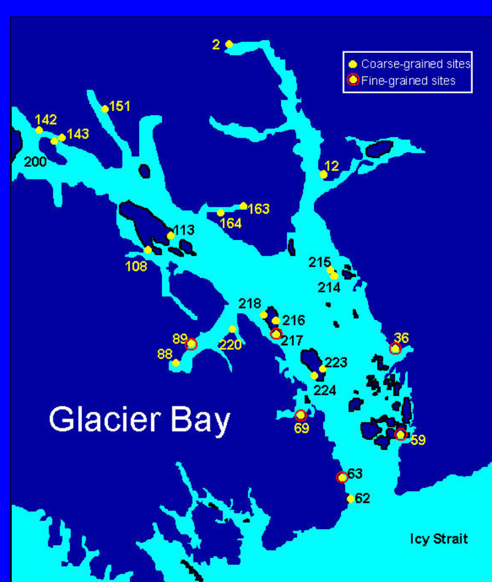
- Randomly selected 30 sites of selected habitat type for sampling (ultimately sampled 25)
- Selected a subset (n=6) of the 25 for more intensive sampling

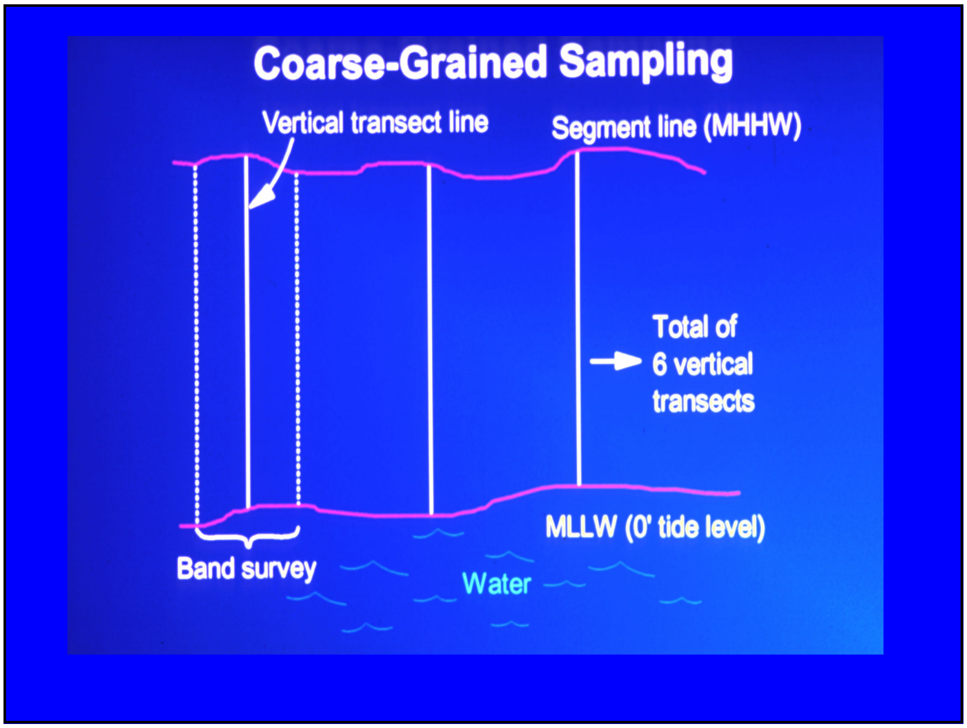
Levels of Design in this Study

- Identification of random/systematic set of segments with known habitat types
- Coarse-grained:
  - Low intensity sampling of many (n=25) randomly selected sites of the selected habitat type
- Nested sampling (Fine-grained):

  High intensity sampling of few (n=6) of the 25 sites

Study Sites




Coarse-Grained Sampling
Vertical transect line
Segment line (MHHW)
Total of
6 vertical
transects
MLLW (0' tide level)
Band survey
Water

Comparison of Coarse-grained and Fine-grained Sampling (vertical transects)

- Coarse-grained: *6 vertical transects/site*
  originally 1 point/meter
- Fine-grained: *10 vertical transects/site*
  5 points/m

Sampling Methods used at Fine-grained Sites

- Vertical Transects: *10 transects/site, 5 points/meter*
- Horizontal Transects: *30 transects/site (10 in each of 3 elevational zones), 5 points/m*
- Quadrats: *30 quadrats (10 in each of 3 elevational zones), 36 points/quadrat*

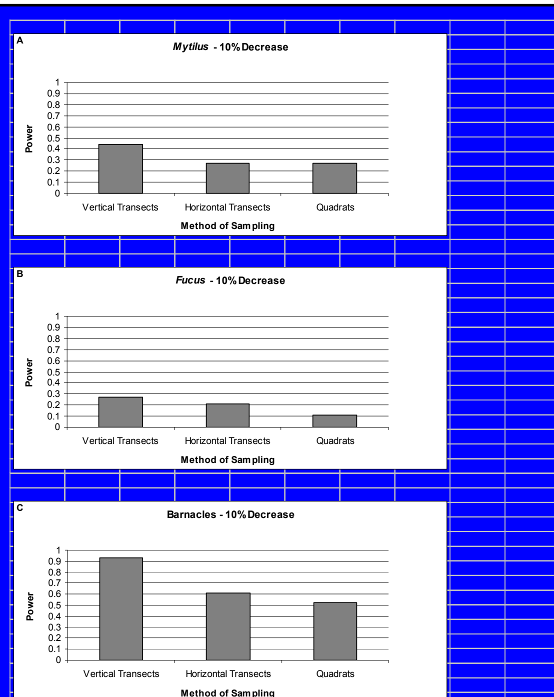
How did we want to use MONITOR?

- To compare sampling schemes:
  - Coarse-grained vs. Fine-grained
  - To compare power of different sampling methods (e.g. quadrats, vertical and horizontal transects)

MONITOR Parameters

MONITOR Attributes	Values we used
Number of plots	Number of sites
Number of counts /survey occasion	Number of transects
Magnitude of counts/plot	Mean %cover of transects/site
Variation in counts/plot	RMS residual
Plot weighting	Equal (=1)
Number of surveys conducted	Various (e.g.,4)
Occasions of those surveys in time	0,1,2,4
Linear vs exponential trends in population	Exponential
Variation in trends among plots	Set at 0 (default)
Significance level	Usually alpha=0.05
Number of tails in statistical tests	2-tailed
Whole vs fractional counts	Decimal
Constants used in data transformations	1

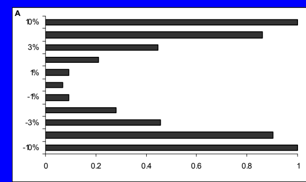
Power Analyses: Comparison of Methods (FG sampling)



Power Analyses: CG sampling, 4 surveys (1997-2001)

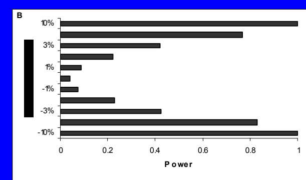
Barnacles

Population Trend	Power
-10%	1
-5%	0.904
-3%	0.458
-2%	0.28
-1%	0.092
0%	0.068
1%	0.094
2%	0.212
3%	0.446
5%	0.862
10%	1



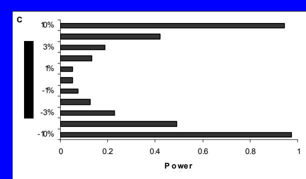
Mytilus

Population Trend	Power
-10%	1
-5%	0.83
-3%	0.424
-2%	0.23
-1%	0.072
0%	0.04
1%	0.09
2%	0.222
3%	0.42
5%	0.768
10%	1

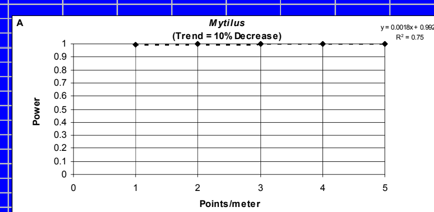


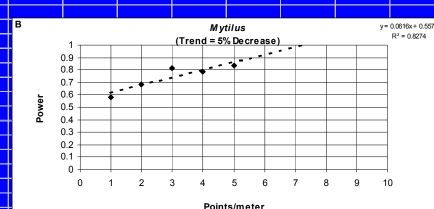
Fucus

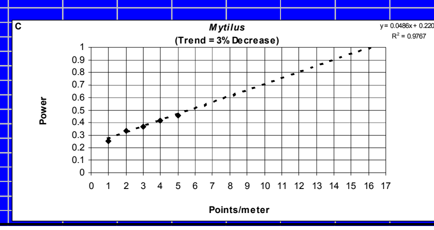
Population Trend	Power
-10%	0.974
-5%	0.49
-3%	0.228
-2%	0.124
-1%	0.072
0%	0.052
1%	0.052
2%	0.132
3%	0.188
5%	0.422
10%	0.944



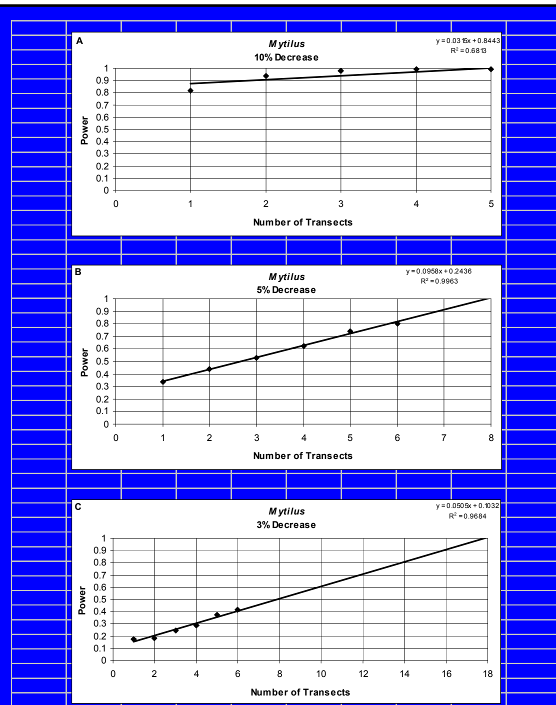
Power Analyses: Mytilus, varying # pts/meter (1998-2001)



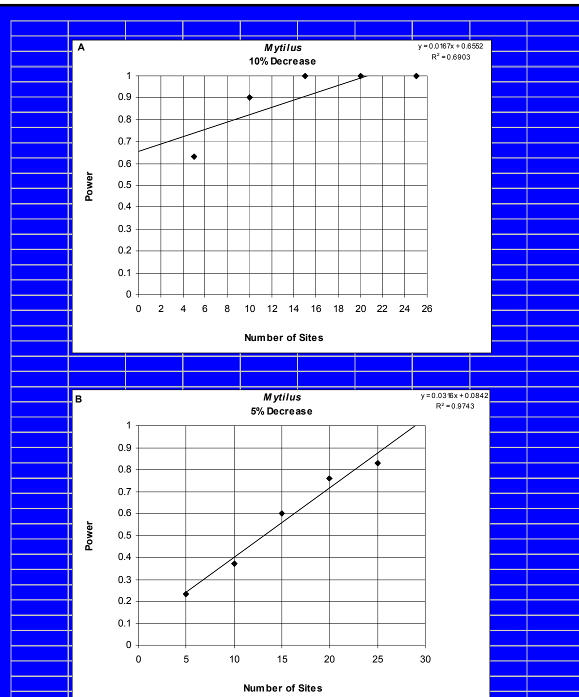




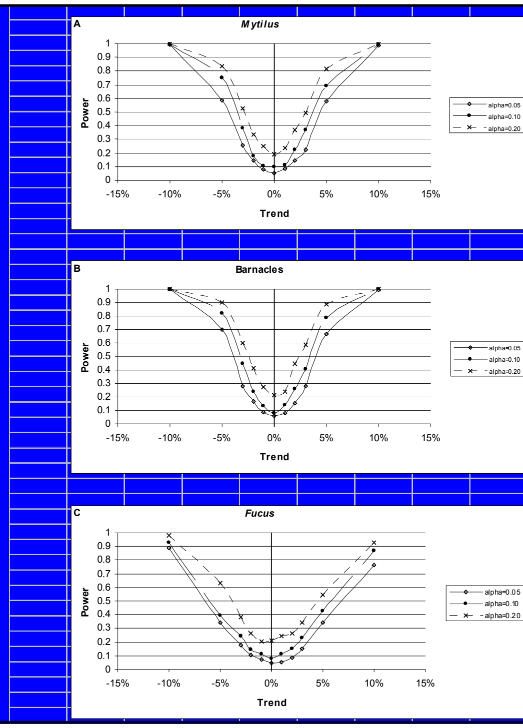
Power Analyses: Mytilus, varying # transects (1998-2001)



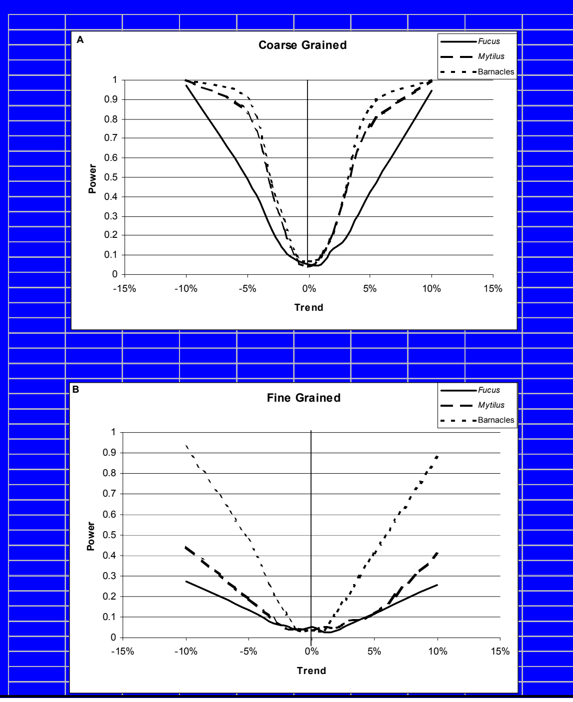
Power Analyses: Mytilus, varying # sites (1997-2001)



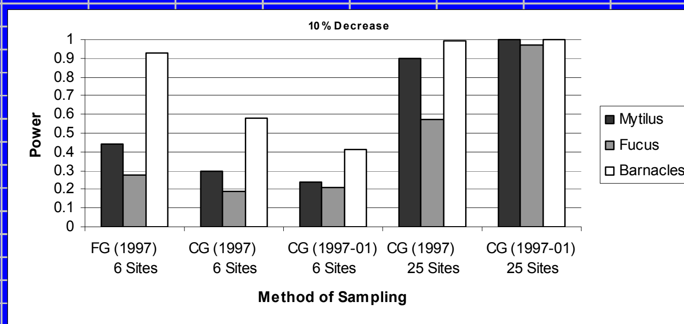
Power Analysis: varying alpha



Power Analysis: Coarse-grained vs. Fine-grained Sampling



Power Analysis: Coarse-grained vs. Fine-grained Sampling (vertical transects)



Summary of Monitoring Design Findings

- There are consistent differences among species in the ability of sampling to detect trends (e.g. barnacles>mussels>Fucus)
- Power was increased by increasing the number of: sites, transects, points sampled/m; and also by increasing alpha
- Sampling conducted at many sites but at a lower intensity had greater power to detect change in the abundance of the major intertidal species than did more intensive sampling at a few sites

Comments

- Even though it might be possible to sample fewer than 25 sites, sampling this number provides a broad spread of sites in a variable environment
- The number of points sampled/m could be decreased, but a more points sampled increases the probability of detecting less common species.

Questions

- What are known (or unknown to me!) pitfalls of MONITOR use?
- We used MONITOR extensively to analyze the design elements for monitoring. What is the preferred type of analysis for continuing to analyze trends through time?
- We know that the abundances of the species I featured are not independent. Which analyses might be recommended that can deal with their combined relative ups and downs? Multivariate analyses?

More Questions

- What is the relative advantage of systematically selected sites vs. randomly selected? It appears easier to modify the design with randomly selected sites.
- Are panels of sites a good idea in this situation? If high power to detect change can be achieved by sampling alternate years, what recommendations are there for how or whether a subset should be sampled annually?

Contributors !

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